

TYING UP LIONS: MULTILATERAL INITIATIVE ON MALARIA COMMUNICATIONS: THE FIRST CHAPTER OF A MALARIA RESEARCH NETWORK IN AFRICA

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Abstract. “When spider webs unite, they can tie up a lion” (Ethiopian folk adage). The Multilateral Initiative on Malaria Communications Network (MIMCom) facilitates a new way of doing research in Africa and African scientists’ participation in the international scientific community. The MIMCom supports full access to the Internet and the resources of the WorldWide Web at 19 research sites in 11 African countries. Furthermore, the MIMCom project comprises two websites: one includes links to resources, databases, and publications as well as a document delivery service for full text journal articles, and the other is a research agenda specific website with a server for a research network desiring to share raw data. Other important components of MIMCom are training and evaluation components. The MIMCom was conceived in 1997 by African researchers and has been designed, implemented, and overseen by the U.S. National Library of Medicine in collaboration with partners in Africa, the United States, and the United Kingdom. This project demonstrates clearly that it can make a positive difference in the functioning of remote research sites in Africa, in terms of site growth and productivity and in the professional lives of individual researchers. This report reviews the project’s background, methods of operation with an emphasis on local needs and priorities, cost effectiveness, and local responsibility; results focusing on a technical network; documentation of the system and two-way exchange of information; the MIMCom website; a network approach to research; and financial sustainability. The report concludes with summaries of evaluations by an independent panel, the Multilateral Initiative on Malaria Secretariat, and the U.S. National Library of Medicine.

INTRODUCTION

The Multilateral Initiative on Malaria (MIM), a consortium concept, evolved from a meeting of malaria researchers and funding organizations from around the world in Dakar, Senegal, in 1997. The communications mandate, to be led by the U.S. National Library of Medicine (NLM) as a part of the U.S. National Institutes of Health’s commitment to MIM, came from the scientists themselves: “Access to e-mail and the Internet will promote rapid communication between investigators working at different sites as well as access to online literature and data available to scientists outside Africa. Subsequent development of electronic networks would promote the use of common databases which will facilitate research efforts at multiple sites across the continent.”¹

Why the U.S. National Library of Medicine? In the summer of 1997, as the NLM was embarking on this international challenge with the Multilateral Initiative on Malaria, it took the bold step of making MEDLINE®, its premier database of medical literature, available free to the networked world through PubMed®. PubMed is a service of the NLM that includes more than 14 million citations for biomedical articles from MEDLINE and additional life science journals and links to many sites providing full text articles and other related resources. Free MEDLINE makes it possible for anyone with access to the WorldWide Web (WWW) can search MEDLINE, read abstracts, and carry out research, privileges previously reserved for the province of medical libraries and those with access to these resources. The MIMCom provides an ideal application for PubMed to reach underserved areas of the world.

The NLM houses the largest biomedical collection in the world and has a long history of including journals from many countries. Under the leadership and vision of Director Donald A. B. Lindberg, MD, who is a pioneer in medical

informatics, NLM has gained prominence as a promoter of technology in support of medical information dissemination.

The NLM’s Long Range Plan 2000–2005 further reinforces global health partnerships: “The increasing globalization of knowledge has made it clear that domestic and international functions of the NLM are not separable. . . . It is important that NLM carefully select targets of opportunity for involvement in areas of the world where NLM can make a difference.”² Although prior to involvement with the MIM the NLM had not carried out projects in sub-Saharan Africa, the library enjoys a good reputation in these areas via MEDLINE on CD-ROM.

Good communication and access to information are extremely important in Africa. In the international research community, these tools are essential to the science of the 21st century. On the other hand, simply putting in the pipes of telecommunications infrastructure does not by itself serve the researchers’ ultimate commitment to better health. These tools, along with an input of funds and resources, need to be the building blocks of an integrated conceptual framework. This framework should include a matrix of the goal of better health supported by a clear defined research agenda, backed by training, tools for information retrieval, and an evaluation system as shown in Figure 1. To this end, the choice was made to pursue a strategy that allows researchers to become actively engaged with making the technology make a difference. The challenges and successes of this approach thus far are the topic of this report.

MIMCOM METHODS OF OPERATION

The initial question to be addressed by individuals working at a research site in Africa is this: what is it that researchers are trying to accomplish but cannot, given current telecommunications access? The project focuses on the researcher and her or his particular challenges in being part of the inter-

MALARIA RESEARCH NETWORK

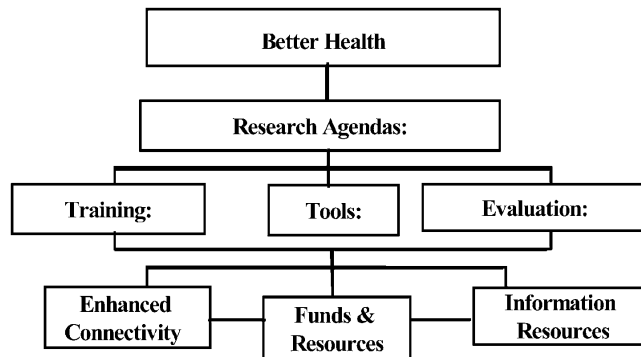


FIGURE 1. Malaria Research Network: The Conceptual Framework.

national malaria research community. The MIMCom project follows a collegial development model in which the NLM shares tools and expertise with the researchers, so that the latter can better achieve their research goals. The project is built on the following three tenets: 1) an emphasis on the local needs and priorities, 2) cost-effectiveness, and 3) local responsibility. These are explained in the proceeding sections.

An emphasis on local needs and priorities. The MIMCom project team's first step is to make site visits before any particular technologies are even considered. Initial surveys document scientific aims as well as available telecommunications capacity to carry out those aims. The team examines and evaluates local telecommunications availability to gain access to the WorldWide Web, sends e-mail and large data files, and downloads large documents. When capacity to do these tasks is not available through local Internet Service Providers (ISPs) or part of a local telecommunications strategy, the MIMCom team researches other options that rely on satellite, microwave, or other wireless options.

For example, there was no sufficient local option for the research to be carried out at MIMCom's two initial sites in Kisian and Kilifi in Kenya. The solution deemed most appropriate and cost effective by the MIMCom team was a separate very small aperture terminal (VSAT) system. The technical hub for this VSAT system is located at Redwing Satellite Solutions, Ltd. (Brookmans Park, Hertfordshire, United Kingdom) where a large satellite dish, focusing on a geostationary satellite 22,000 miles above the Atlantic Ocean, is connected directly to the high-speed Internet backbone on the ground. At Kisian and Kilifi and at subsequent research sites with no local telecommunications service, a ground station in the form of a VSAT is installed. The VSAT 2.4-meter dish antenna connects, through a radio unit, to an existing local area network (LAN) used by researchers at the site. The system provides a full time open link that allows researchers to send and receive e-mail, search the literature and databases, or share files and images.

Eight other research sites have since joined this VSAT system: Noguchi and Navrongo in Ghana, Nairobi and Mbita in Kenya, Ifakara and Amani in Tanzania, Lambarene in Gabon, and Entebbe in Uganda. Other research sites that are part of the MIMCom family in Kampala, Uganda, Dar es Salaam, Tanzania, and Blantyre, Malawi operate wireless

connections to a local ISP. Still another site in Yaounde, Cameroon, uses an alternative VSAT solution.

Cost effectiveness. All aspects of the project emphasize coordination and cost savings. For the shared VSAT system described, the NLM negotiated a group buy of VSAT capacity and management from Redwing Satellite Solutions, Ltd., a small, flexible satellite services company. Redwing was intrigued by the challenge of the mission of the MIM and created a then unique structure of sharing bandwidth for this purpose. More than 1,000 researchers and support personnel are currently benefiting from buying bandwidth as a group. This underscores the positive benefits of sharing, even at the technical level.

Local responsibility. One immediate objective is to enable local sites to become more responsible in terms of troubleshooting as well as in using valuable bandwidth resources efficiently. To encourage creative problem solving on all levels by the systems operators at each site, MIMCom has designed and implemented a List Server, a Help Desk, an Intranet, and a usage policy, as well as tools that monitor usage, and tools that block unrelated websites so that valuable telecommunications resources are not consumed.

RESULTS

This section outlines the results of the MIMCom project thus far. Each exemplifies a critical element of the program. Taken together, they illustrate the importance of technology being targeted, as in the case of any effective intervention, and used efficiently and creatively. The challenge, then, is not simply the installation of telecommunications services, but encouraging innovative ways of communicating and conducting scientific research. What is needed, beyond local vigilance for sustaining the network, is support for African-to-African connections in African-led research agendas. This support can take various forms of capacity building, but must focus on collegial sharing if the voice of people working in malaria endemic areas is to be heard.

The first malaria communications research network established and growing. Despite the challenges of lightning storms, rainy seasons, poor or non-existent telephone lines, lack of back up generators, rugged terrain, and sometimes wild animals on the satellite dish, equipment has been and continues to be installed and made to work, thus creating MIMCom, the first malaria research communications network. What is new for many researchers in Africa is access to a telecommunications tool and the resources it can open.

At present, the MIMCom network (Figure 2) includes enhanced telecommunications installations (11 VSAT and 4 microwave) at 15 malaria research sites in Kenya, Ghana, Tanzania, Malawi, Cameroon, Gabon, Mali, and Uganda. Each central installation connects local users via a wireless wide area network and/or a local area network. These stations serve approximately 1,000 users, which include researchers and doctors as well as administrative personnel.

Three additional sites will soon join the MIMCom network family: the Malaria Research Laboratory at University of Ibadan in Nigeria; a project of the Water Reed Army Institute of Research at the Finlay Tea Plantation in Kericho, Kenya; and the Centre National de Recherche et de Formation sur le Paludisme in Ougadougou, Burkina Faso. Addi-

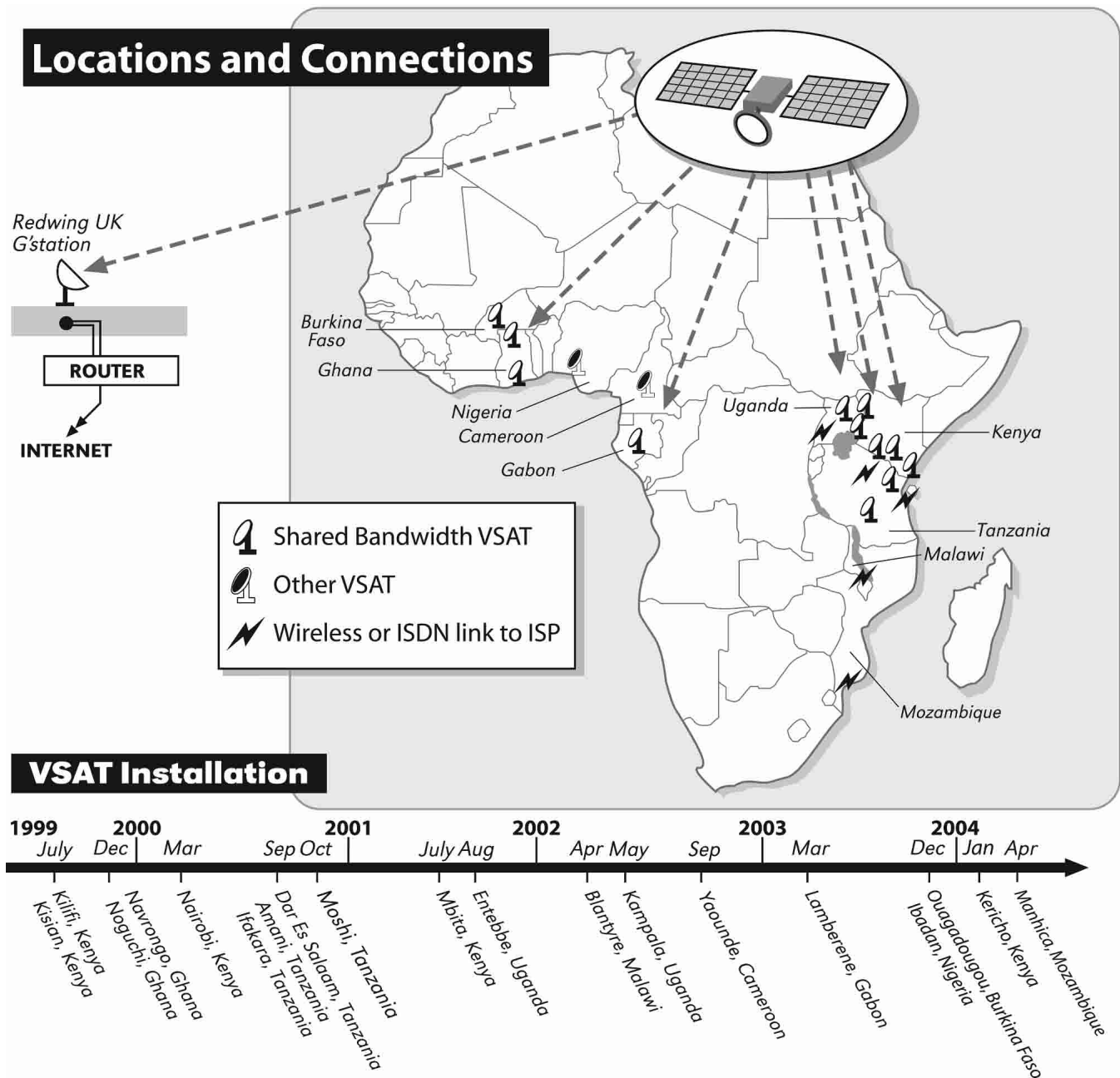


FIGURE 2. Multilateral Initiative on Malaria Communications Network (MIMCom) sites. UK = United Kingdom; G'station = generating station; VSAT = very small aperture terminal; ISP = Internet Service Provider.

tional potential sites include the Komfo Anokye Teaching Hospital in Kumasi, Ghana and the Manhica Research Center in Manhica, Mozambique, just outside of Maputo. As in the case of the other sites, these also assume costs for hardware, software, and operations.

Documentation of the system. The MIMCom project seeks to address the age-old problem of system documentation from past telecommunications projects in Africa. The lack of footprints, much less blueprints, from these efforts has often led to much wheel-reinvention and waste of resources. In response to this, MIMCom makes a concerted effort to produce extensive technical documentation that includes manu-

als for users and systems operators on troubleshooting, an introduction to e-mail and the Worldwide Web, as well as thorough background information on each of the research sites. The MIMCom manuals, which have been distributed throughout the MIMCom system, include Network Management; General Background to the MIMCom Network; Networking and Internet Technologies; Setting Up and Managing a Windows NT Server; Introduction to E-mail; Using the Worldwide Web; Keeping Up to Date; Central Technical and Support Document; Keeping PCs Running Efficiently; MS Proxy Server 2.0; Exchange 5.5; Troubleshooting Internet Connectivity Problems; Domain Naming Service; Managing

Internet Bandwidth Resources: A Manual for Systems Operators; Optimization of the Network; and Details of Remote Sites. This documentation is expanded on an archival website (URL) at the NLM that contains accessible copies of the manuals as well as all other aspects of the project that can be obtained on-line.

The two-way street established. The idea of a two-way street of communication and exchange assumes that information flows collegially in two directions. In further support of the collegial model, the electronic access of the NLM enables important information from scientists writing in endemic areas to be part of an international dialog. Not only do African scientists have an opportunity to read what their colleagues worldwide are doing, but the scientific world inside and outside of Africa has access to research being carried out in Africa. The latter, though still nascent, is being achieved through active solicitation of journals to be considered for inclusion in MEDLINE and through projects that strengthen African medical libraries.

MIMCom website. The MIMCom website www.nlm.nih.gov/mimcom/ (Figure 3) was created to provide easy access to information on malaria, databases, medical reference resources, Internet resources, publications, and document de-

livery. Users can find out more about the MIMCom network and explore the research interests of participating sites; search major databases and medical reference resources on genomics, malaria acronyms, malaria reference, pharmacology, reagents, and vaccine; order full-text documents for free and access a number of journals, guides, books, and reports; learn more about how to use the Internet and participate in discussion groups; and discover funding opportunities, meeting schedules, and training materials. The MIMCom website currently resides at the NLM where it is managed by an experienced webmaster and reference librarian. When a new entry is posted by the webmaster, an e-mail alert goes out to those who have signed up. The site is updated regularly with information from a wide variety of sources.

A network approach to research: African-to-African collaboration in the Antimalarial Drug Resistance Network.

This project addresses the need for supporting scientists in making innovative use of their new research tools to facilitate new ways of working together. A demonstration of this concept with tangible results comes from a workshop on Communication and Team Building in the spring of 2002. Held at the Glenholm Center in Broughton, Scotland, it was sponsored by the NLM in collaboration with MIM/TDR, a funding

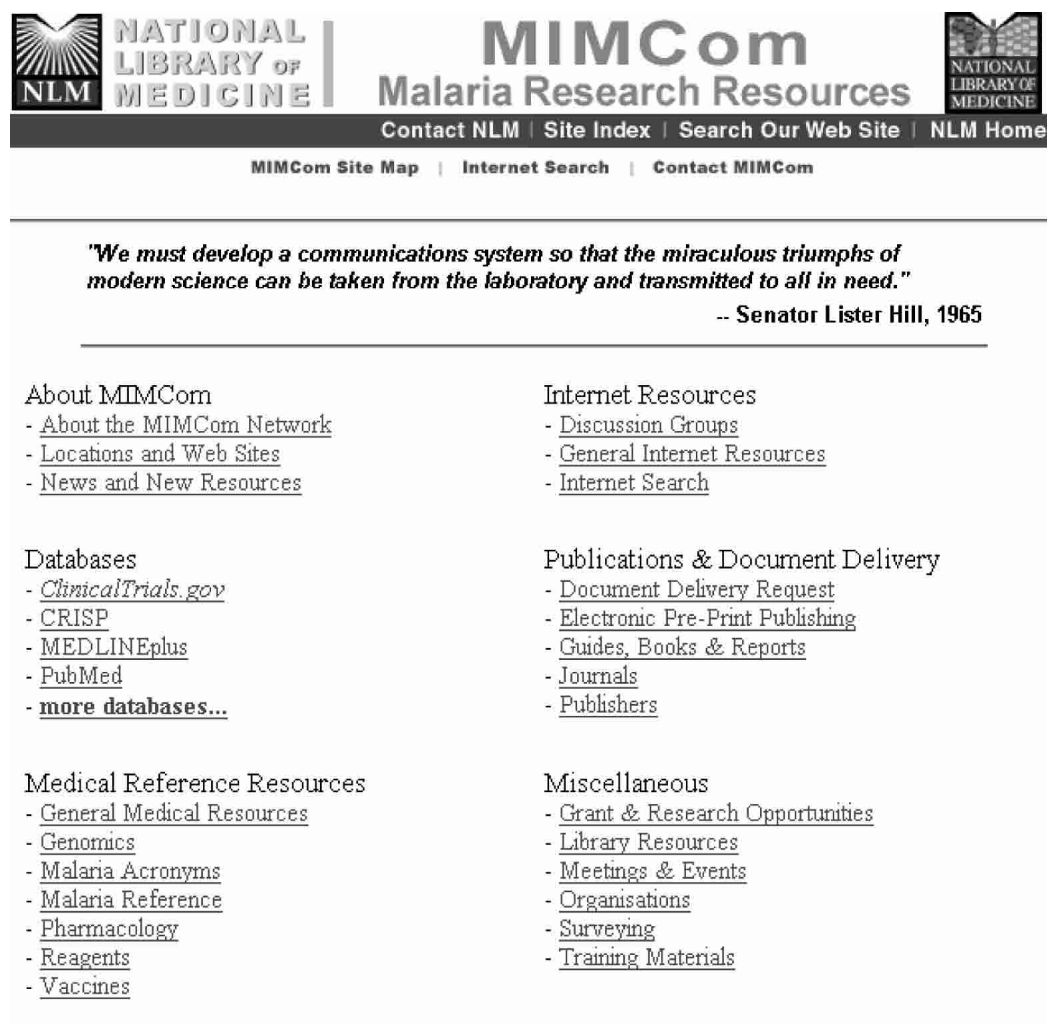


FIGURE 3. Multilateral Initiative on Malaria Communications Network (MIMCom) Malaria Research Resources Website. CRISP = Computer Retrieval of Information on Scientific Projects.

mechanism supported by MIM partners and managed by the United Nations Development Project/World Bank/World Health Organization (WHO) Special Program for Research and Training in Tropical Diseases (TDR.) Participants at the workshop were principal investigators and data managers from the five research groups that are part of the MIM/TDR Antimalarial Drug Resistance Network. The network's investigators are from the Noguchi Memorial Institute for Medical Research in Accra, Ghana; the Malaria Research and Training Center in Bamako, Mali; the Malaria Research Group of the Postgraduate Institute for Medical Research and Training at University of Ibadan in Nigeria; the Ifakara Health Research and Development Center in Ifakara, Tanzania; and the MED Biotech Laboratories and Makerere University in Kampala, Uganda. Prior to this workshop, the group met to develop a protocol and identified the critical need for tools and mechanisms for acquiring data, storing data, and monitoring the progress of the project.

The workshop was facilitated by staff and scientists from the NLM, WHO/TDR, the U.S. Centers for Disease Control and Prevention, the Severe Malaria in African Children network, and communications experts. The six-day workshop was interactive with discussions focusing on database design and data management in a multi-center project; team dynamics and problem solving; web design; and strategies for effective use of the WorldWide Web, information technology, and on line databases for biomedical research. This occasion provided opportunity for the investigators to present an update on the activities at each site and discuss immediate challenges.

As part of this process, the principal investigators developed and agreed to a memorandum of understanding covering the collaboration, including data sharing, security of the database, publication of research data, and development of a web site. They designed a web site for the network comprising a publicly accessible section and one that is password protected. The latter, accessible to network investigators and funding partners exclusively, contains a summary of the activities at each site. Responsibilities for developing the pages on the site were divided up among the investigators attending the workshop.

The researchers also agreed to use a secure file transfer protocol (SFTP) server to which they would upload their raw data on a regular basis. This arrangement gives them access to their own data and to view that of others. A network manager has full access to all data. The TDR agreed to host a list server to facilitate communication and discussions within the network. The NLM was asked and agreed to host the website as well as the SFTP server (Figures 4 and 5). The website and the SFTP server were operational by 2003.

Financial sustainability strengthened. The method of financing the MIMCom project also strengthens the basic project goals. Rather than one large northern organization funding the entire project, the operations costs are shared among sites by the agencies funding research at each venue. The project director's intent is to help funding organizations view telecommunications as essential to the process of carrying out research, much as refrigerators and vehicles are. The belief is that efficient use of a limited resource should be achievable, sustainable, and not subject to the vicissitudes of funding. The fiscal mechanism within the U.S. government for collecting funds from a variety of agencies and organizations requires procedures and steps that bring challenges. Nevertheless, this

project successfully met these challenges. Table 1 shows the partnership among a diverse set of funders for the MIMCom project. This partnership is unique and has shown a promising beginning. From October 1, 1998 to September 30, 2002, project expenses for the 13 MIMCom sites were approximately US \$1.7 million and included equipment purchase, operation costs, support contractors, and workshops. These costs do not include the additional contribution by NLM of the project director's salary, travel, and office. Nor do they include the contribution of NLM librarians and engineers who have given of their time to the project. Most sites contribute significantly to the system through their purchases of additional hardware and software and through the hiring of system operators.

The justification for financial expenditure on telecommunications needs to be contrasted to what is currently being spent by some sites on poor communications (in Kenya, for example, the telephone bill at one site was twice the monthly charge of VSAT operation; the new means of communication, therefore, proved cost-effective); isolation experienced by sites as a result of lack of telecommunications; inability to collaborate with other researchers, communicate with funders, or submit proposals, reports, or papers for publication in a timely fashion; ordering supplies; and the general administrative business of a site.

MIMCOM EVALUATION


Evaluation continues to be an integral part of MIMCom development. The results of examinations of the project by independent panels and individuals have been critical to assessing the project's effectiveness. To this end, three separate evaluations have already taken place with the summary of the results briefly outlined in the next three sections.

Independent panel. The first outside panel was convened in September 2002 by the MIM Secretariat, then at U.S. National Institutes of Health in Bethesda, Maryland, and charged with conducting an independent review of the MIM. The following comments by African researchers are excerpted from a report that confirmed the importance of MIMCom to African researchers. "We're not so far away anymore," said one researcher. "We're finally 'here.'" "Increasing the connectivity of African scientists both with each other and with scientists in the rest of the world is a role that has played well. Electronic access to journals and a new ability to communicate easily with other scientists, together with MIM-provided opportunities for face-to-face meetings at workshops and conferences, has greatly facilitated African capacity development."³


The report continues, "The high-speed Internet connection to the WorldWide Web and e-mail has created an almost entirely new set of opportunities for the scientists. Many of the sites feel that they would no longer be able to function without this facility and regard the enhancement of connectivity as a significant step toward reducing the inequities of research advantages in the North compared with the South."³

A senior researcher from Cameroon, working at the remote International Centre of Insect Physiology and Ecology research site in Kenya, underscores and personalizes the importance of this connectivity tool. "Improved working relationships with our colleagues is perhaps the most important result of the network. Before, we were left out of the south-

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Antimalarial Drug Resistance Network: Building Evidence for Control Policy

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Summary

Five study sites in Africa are systematically addressing resistance *P. falciparum* to antimalaria drugs and establishing the role of known and new markers of drug resistance. During the last 3 years investigators leading 5 collaborative research projects in Ghana, Mali, Nigeria, Uganda and Tanzania with partnerships in the US and Switzerland, focused on validating laboratory and clinical protocols for evaluating drug resistance. The 5 projects have emerged into a network for better understanding of drug resistance in malaria.

FIGURE 4. Multilateral Initiative on Malaria Tropical Diseases Research (MIM-TDR) Antimalarial Drug Resistance Network (ADRN). SOPs = Standard Operating Procedures.


south network and the south-north network, because we didn't have access to information or a way to contact our partners. MIMCom has dramatically improved our working relationships with colleagues at sites in the south and north.... MIMCom assists developing countries to enter and participate fully in the information revolution. For us, it is a real support tool for sustainable development."⁴

Another senior scientist at the Kenya Medical Research Institute in Kisumu, Kenya shares this sentiment: "It is fantastic because it removes those old barriers which were about controlling information, because information is power. Those who control information control the systems, so if you break those barriers, you can access resources. More so, you have much better access to information which you can use for policy formulation or designing projects or gathering data, presenting findings, packaging it for policy makers in our country or elsewhere. It's so good. . . . We are a part. We manage projects, some set in Maryland, some set in UK. We run projects in Africa. We forward mail to each other. We plan

and agree and disagree. It is not one man writing a letter, giving instructions. There is a difference here. It's a completely different way of communicating."⁵

The external panel concluded that the "creation of MIMCom has provided isolated scientists with tools that bring the whole world closer. Reliable communication with collaborators and vastly improved access to the scientific literature have both increased the reach of African scientists and facilitated their participation in the broader scientific world, especially by improving their potential to publish in world-class journals, a key part of being a mainstream scientist."³

Multilateral Initiative on Malaria Secretariat Evaluation. In December 2002, the new MIM Secretariat in Sweden conducted a survey of researchers working in Africa: with respondents from 25 countries; 70% African and 30% non-African; 78% senior researchers and 22% junior researchers; and 24% female and 76% male. "MIMCom is viewed by many (86%) as one of the most successful and important contributions of the MIM, and it is strongly recommended


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"We must develop a communications system so that the miraculous triumphs of modern science can be taken from the laboratory and transmitted to all in need."

-- Senator Lister Hill, 1965

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FIGURE 5. Multilateral Initiative on Malaria Tropical Diseases Research (MIM-TDR) Antimalarial Drug Resistance Network (ADRN) Teaching Databases and Sites. SOPs = Standard Operating Procedures.

that MIMCom continues to expand the network to new sites and be involved in the subsequent steps of IT-training and management...further expansion and development of associated activities such as more access to online journals and forming web-based research networks was very much desired. The training of on-site IT specialists is identified as very important for the sustainability of a functioning local network."⁶

Evaluation by the U.S. National Library of Medicine. Finally, the NLM carried out its own evaluation of the effects of enhanced connectivity on professional performance of malaria research staff on 181 malaria research staff at the first eight MIMCom malaria research sites (Nairobi, Kilifi, Kisian, Mbita Point, Amani, Ifakara, Navrongo, and Noguchi) with the use of a web-based questionnaire. The condition for evaluation was that the site should have had access for at least six months to enhanced communication through a VSAT supported by MIMCom/NLM. Both multiple choice and open questions were used to extract information and suggestions from participants. The questionnaire was pre-tested and tested at one of the MIMCom sites and was implemented between August 2002 and February 2003. The target group of this evaluation activity encompassed scientists (59.8%), students (14.7%), and support staff (25.5%) in-

involved with malaria research. The participants represent a well-balanced group of both technical and applied malaria research staff and cover a variety of professions and types of work.

In summary, taking into account the explanations and open answers given in response to the questionnaire, it can be said that enhanced connectivity is generally experienced as a positive contribution to professional performance. It gives access to a world of up-to-date scientific information, facilitates efficient communication, allows effective coordination of research activities, and offers improved possibilities for capacity building. The VSAT system makes an interesting contribution to those who are professionally in touch with donor organizations; 90.7% mention that their contact with donors has improved because of better communication. Among those participants who are involved with promoting their institute, almost all (98.4%) contribute to enhancing the visibility of their institute by sending e-mails about their work and institute.

Enhanced connectivity is successful in providing access to scientific up-to-date information and contributes to improved coordination of research activities. It enables Africa-based malaria researchers to participate in the global scientific community, stay in touch with the latest developments, and im-

TABLE 1
Multilateral initiative on malaria communications: a consortium of local and international partnerships

Site	Local partners	International partners
Cameroon	The Biotechnology Centre, Faculty of Medicine and Biomedical Sciences University of Yaoundé 1 (Yaoundé)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
Gabon	Medical Research Unit, Albert Schweitzer Hospital (Lambaréné)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
Ghana	Noguchi Memorial Institute (Accra)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
	Navrongo Health Research Center (Navrongo)	Naval Institute of Medical Research (NIMR) US Agency for International Development (USAID)
Kenya	Kenyan Medical Research Institute (KEMRI) (Nairobi)	US National Library of Medicine (NLM) US Walter Reed Army Institute of Research (WRAIR) US Centers for Disease Control and Prevention (CDC)
	KEMRI/Wellcome Trust (Kilifi)	US National Library of Medicine (NLM) Wellcome Trust (United Kingdom)
	KEMRI/CDC (Kisian)	US National Library of Medicine (NLM) US Centers for Disease Control and Prevention (CDC)
	International Center of Insect Physiology and Ecology (ICIPE) (Mbita)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
Mali	Malaria Research and Training Center, Faculté de Médecine (Bamako)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH) (Initial support for a microwave connection that led to installation of an independent very small aperture terminal system.)
Malawi	College of Medicine/Pediatric Malaria Project/Wellcome Trust (Blantyre)	US National Library of Medicine (NLM) United Kingdom Wellcome Trust
		US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
Tanzania	National Institute for Medical Research (NIMR)	US National Library of Medicine (NLM)
	Amani Medical Research Center Ifakara Health Research and Development Center	US National Institutes of Health (NIH)/Office of the Director
Uganda	Makerere University/Mulago Hospital (Kampala)	US National Library of Medicine (NLM) US National Institute of Allergy and Infectious Diseases/National Institutes of Health (NIAID/NIH)
	Ugandan Viral Research Institute (UVRI) (Entebbe)	US Centers for Disease Control and Prevention (CDC)

prove the often-isolated position of researchers on the African continent.⁷

CONCLUSION

"When spider webs unite, they can tie up a lion," the opening quote in this article, implies both strength and fragility. This report and the project's evaluation illustrate the strengthened capacity that is evident among scientists working in Africa thus far. However, the IT intervention and infrastructure must aim not only to establish itself more firmly, but be engaged by researchers in new ways that will make a difference in the morbidity and mortality of malaria in Africa.

One can conclude that several key issues must be and are being addressed regarding the future of MIMCom. These include 1) the expansion of service to include smaller sites, as well as a redesign of the network to encompass growth of extant sites, incorporating a variety of technology solutions; 2) the proactive use of the MIMCom network to support the Malaria Research and Reference Reagent Resource Center (MR4), MIM/TDR (a multilateral funding mechanism set up

by the United Nations Development Program/World Bank/World Health Organization Special Program for Research and Training in Tropical Diseases), and other research agendas of MIM through distance education, workshops on site and off site, and training opportunities, using a variety of media, both live and electronic; 3) moving the MIMCom base and leadership to Africa through a program of mentorship and training; and 4) broadening the base of support from predominantly the United States to include agencies, foundations, and members of the private sector from around the world.

Rather than reinforce old structures, this new tool makes possible new collaborations that bring new hope and new voices to the old world of science. The ultimate endpoints, after all, are increased capacity among scientists in Africa to carry out their work and a decrease in the disease burden. So while we end this report with a small web called MIMCom, we begin the real work as we imagine what might be.

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